AN APPLIED BEHAVIORAL ANALYSIS OF THE EFFECT OF SCHEDULE CHANGE ON ACADEMIC VERBAL BEHAVIOR AT THE UNIVERSITY OF FLORIDA

BY

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This dissertation is dedicated to Donald L. Avila,
and other educators and psychologists working to unite a humane
philosophy with behavioral technology.

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The general problem this study was concerned with was that of measuring pupil success in learning. Specifically, the study focused on the effect of changes in schedules of reinforcement on frequencies of correct verbal responding.

The purpose of the investigation was to study the process of learning as it relates to pupil success or outcomes. The aspect of learning which was considered most important in the study was the functional relationship between behavior and its reinforcers. In short, the operant model was used in the study.

The behavior studied was frequency of correct verbal responses to performance items taken from a basic text in human growth and development. Responses were emitted during a performance session within an experimental chamber. Students demonstrated mastery of curriculum material in performance sessions by reading questions and stating the answers to the student-manager. The maximum duration of the sessions and the types of items were held constant throughout the experiment. The three schedules which were manipulated during the experiment were no schedule (baseline), CRF (continuous reinforcement), and an intermittent schedule, VR5 (variable ratio 5). Under these

schedules the experimenter delivered a generalized reinforcer of five cents.

The results showed that there were no significant differences in correct response frequencies during training or during extinction. There were no significant differences in accuracy ratios during training. However, there were significant differences, $p < .01$, in accuracy ratios during extinction between baseline, CRF and VR5. There were no significant differences in celeration ratios during training or during extinction.

The data as shown in the summary charts suggest that the treatments (CRF and VR5) had a beneficial effect in the retention of academic content acquired during training.

The findings of this study make it imperative that further research using the operant model in academic settings be conducted in order to establish the feasibility of using different variable schedules of reinforcement at all levels of education.

It is the experimenter's opinion that future research using operant principles, and applying monetary reinforcement to students, will help find the way to a more efficient educational process. The importance of this study is that the academic behavior of students was paid for directly and the students responded to being paid in a very positive way. The subjects stated at the end of the experiment, that they felt a program paying students to learn would be of great value in the public school systems. This line of research should go a long way toward easing the drop-out problem as education becomes more meaningful to students.

CHAPTER I

INTRODUCTION

Evaluating teacher effectiveness and pupil learning are notorious problems in education. Educators have been unable to discover factors that consistently allow us to identify effective teachers or produce processes which guarantee pupil learning. However, if the current pressures for accountability persist, and this experimenter believes they will, satisfactory answers to these problems must be found.

Teacher effectiveness and pupil success are really two sides of the same coin. Therefore, it seems likely that answers found relating to teacher effectiveness will also supply answers to pupil success, and vise versa. This experimenter prefers to approach the problem from the point of view of pupil success, and has done so in the present study.

Research Approach

The purpose of this investigation was to study the process of learning as it relates to pupil success or outcomes. Since learning is actually a hypothetical construct one must select an approach to the study of learning which begins with the observation of behavior. From such an approach, inferences can be made about the learning process involved. In this experimenter's opinion the best empirical procedures available for the study of learning

are those which are usually classified as operant conditioning techniques and are advocated by B. F. Skinner, Ogden Lindsey, James M. Johnston, H. S. Pennypacker, R. V. Hall, Carl Koenig and others.

Stated simply, the approach suggests that the most important aspect of learning is the functional relationship between behavior and its reinforcers, and that it is an understanding of this relationship that will lead us to techniques which can guarantee pupil success (Pennypacker, 1970).

The implication is that learning is related to the kind of reinforcement it is dependent upon and the way in which these reinforcements are scheduled. Learning will occur, i.e., new responses will appear, if the behaver finds that a given response is reinforced. By the same token, the probability of future occurrences of a response if not reinforced will be reduced. Furthermore, the rate of learning will vary according to the conditions under which the learning occurs. For example, the rate of learning will vary with the amount of reinforcement given, the time lapse between behaving and reinforcement, the number of reinforcements, and the like.

This is an oversimplification of the approach, but it does establish the model upon which the present study is based, the operant model which, as stated above, focuses on the functional relationship between behavior and reinforcement.

The Problem

The general problem that this particular study was concerned with was that of measuring pupil success in learning. The specific aspect of that problem which this study focused upon was the effect of varying rates of reinforcement upon the rate of learning.

The experimenter applied an operant model using techniques and principles derived from the experimental analysis of behavior to college teaching in an investigation of the "learning" process as demonstrated by change in a specific behavior, i.e., correct verbal responding. The effect of three schedules of delivery of a generalized reinforcer was examined to ascertain which schedule generated the highest frequencies of correct verbal responding and the most resistance to extinction.

The behavior was measured in terms of frequency of correct verbal responding. The behavior was studied during "performance sessions" within an experimental chamber designed to fit the morphology of humans. The maximum duration of the performance session and the type of performance item were held constant throughout the experiment. A generalized reinforcer (five cents) was delivered to the Ss under three schedules: no schedule (baseline); continuous reinforcement (CRF); and an intermittent schedule (VR5).

This experiment was an examination of the changes in on-going academic performance of four Ss resulting from the manipulation of three schedules of delivery of a generalized reinforcer.

Importance of the Study

The importance of this study appears to be two-fold. First, be the results negative or positive, they shed light on the learning process, knowledge of which is presently in such a state of confusion. It is true that there are other studies relating to the effects of different schedules of reinforcement, but none of these studies focus on the particular concern of this study using human Ss.

Second, this experimenter believes that the present study will produce evidence that will bear directly upon the processes of accountability. The concern for accountability has just begun. However, many approaches have already been tried and do shed some light on the question. These include performance contracting, merit pay for teachers, and the like. The effectiveness of any approach, however, has not yet been confirmed or denied conclusively, and many more will be investigated. It appears to this experimenter that one likely avenue to the question of accountability and guaranteed pupil success may be the paying of students as we have already done teachers and administraotrs. If this is true, the present study will be very pertinent to the search for a solution to the problem of guaranteed learning.

Definition of Terms

In order to facilitate the reading of the review of literature and the balance of this study, a definition of terms which are used throughout the study will now be presented.

Accuracy ratio: Frequency correct divided by frequency incorrect.

Baseline: Data on behavior emitted prior to introduction of the independent variable.

Celeration ratio: Celeration correct and celeration error.

CRF: Continuous reinforcement is a schedule in which every correct response is followed by a reinforcer.

Extinction: This is a procedure where reinforcement which followed a response is removed usually resulting in a decrease in the frequency of responding. Functionally extinction is the same as baseline except that extinction comes after a reinforcement phase; however, in this research an extinction phase was added after baseline for statistical purposes.

FI: Fixed interval schedule of reinforcement were reinforcer is available after the passage of a fixed amount of time since delivery of the last reinforcer.

FR: Fixed ratio schedule of reinforcement where reinforcer is delivered after a fixed number of responses.

Line of best fit: This is a straight line drawn through the data, based on the principle of least squares, around which the amount of scatter is least.

Operant: A class of behaviors that operate on the environment to produce reinforcers.

Record floor: Zero point determined by dividing minutes of performance session into one.

Reinforcer: A stimulus which follows a behavior and increases the probability of a future response.

Stimulus control: Refers to a special frequency of performance in the presence of one stimulus.

VI: Variable-interval schedule of reinforcement where reinforcer is available at varying times.

VR: Variable ratio schedule of reinforcement where reinforcer is delivered after a varied number of responses.

VR5: A schedule of intermittent reinforcement known as variable ratio, which means five correct responses on the average are emitted for each reinforcement.

Review of the Literature

The balance of this chapter will present a review of the relevant literature. Only studies using human Ss and those dealing with aspects of reinforcement bearing directly on the present study have been considered. Since the present study deals with examining contingency effects, the manipulation of schedules of reinforcement, and the process of extinction, these are the types of studies included.

Managing Reinforcement Contingencies

One aspect of reinforcement that seems to be important in learning is the management of reinforcement contingencies.

In a study by Walker and Buckley (1968), for example, it was found in an attempt to increase the attending behavior of a nine-year-old male that the use of a controlled setting and the management of reinforcement contingencies was an effective approach. The experimenters collected data to establish a stable response rate of attending behavior. Then they applied reinforcement (which as a check-mark in a book, which when converted to points could be traded for model toys) for an interval of thirty seconds of attending behavior. Slowly, they increased the length of the

interval to six hundred seconds of attending behavior. In effect, the experimenters manipulated reinforcement contingencies which measurably changed the proportion of attending behavior and the frequency of nonattending behavior. The results demonstrate that experimentation within a controlled setting can bring significant changes in operant behavior in humans if the reinforcement contingencies are manipulated systematically.

Hunt et al. (1968) trying to increase cooperative play in a five-year-old female S examined the effects of contingent and non-contingent social reinforcement. They arranged an environment in which the S came under the control of adult social reinforcement. Reinforcement was presented randomly throughout the school day and reinforcement was presented contingent on the child's cooperative play. The experimenters found that cooperative play occurred only when reinforcement was applied contingently. This finding demonstrates the power of contingent reinforcement in an academic setting.

Baron et al. (1969) conducted three experiments to examine the effects of instruction and reinforcement feedback on human behavior. Their findings suggest that instructions can have major influences on the establishment and maintenance of human operant behavior.

In order to examine the effects of using a concurrent fixed-ratio, fixed-interval schedule with two undergraduate male Ss, Sanders (1969) conducted an experiment which focused on a button-pushing task. The Ss worked for money, pushing buttons under a

concurrent fixed-ratio, fixed-interval schedule of reinforcement. An interaction between the various fixed-ratio and fixed-interval performances was produced by manipulating the fixed-ratio requirement. More fixed-interval responding occurred per interval when the fixed-ratio schedule was rich rather than lean. In general, the data were similar to those obtained with lower organisms except that no post-reinforcement pause or ratio strain was observed.

Examining the effects of intermittent reinforcement on children's behavior, Long et al. (1958) conducted an experiment in which children operated telegraph keys or Lindsley manipulanda in individualized cubicles. The Ss were reinforced intermittently with trinkets, pennies, and projected pictures. The Ss ranged in age from four to eight years. The experimental sessions occurred once per week, lasting twenty to thirty minutes. The experimenters applied fixed-ratio, fixed-interval and variable-interval schedules of reinforcement. The results supported the feasibility of controlling the behavior of children through the manipulation of schedules of reinforcement. The data showed that despite unexpected intervening variables, such as holidays, illness, etc., reinforcement schedules systematically applied were able to exercise effective control.

Reynolds and Risley (1971) conducted an experiment to increase talking behavior in a disadvantaged child using social and material reinforcers. A four-year-old female who spoke infrequently was the S. Play school materials were given to the S contingent upon her asking for them. If she did not vocalize her requests, these

materials were withheld. In addition, the S's talking behavior was followed by attention such as smiling, verbal responses, and touching. A high frequency of verbal responding was quickly established. If the materials and attention were only given when the S was quiet, verbalizing decreased. When the materials and attention were given contingent on speaking, the S returned to her original high rate of verbalizing. A further analysis of the data by the experimenters revealed that for this child, the material reinforcers (not social reinforcement) were maintaining improved talking behavior.

Redd (1969) applied three different reinforcement contingencies (contingent, non-contingent and mixed) to two severely retarded male Ss. The contingent schedule of reinforcement gained control of the two Ss' behavior, cooperative play. The non-contingent and mixed schedule did not gain such control.

Redd et al. (1970) paired adults with different contingencies to see what degree of stimulus control they would acquire through association with certain behavior requirements. The Ss behavior was compared when the adults were present. An adult who required a retarded S to emit a particular response in order to receive andy and praise was compared to an adult who reinforced Ss without regard to their behavior. The results demonstrated that an adult who reinforced contingently acquired discriminative properties and functioned on cue which in turn influenced the play behavior of the Ss. The adult who reinforced non-contingently did not acquire these discriminative properties and were ignored by the Ss. These

results suggest that in an experiment using other humans in a manager role, it is critical to control for the acquisition of these discriminative properties which influence behavior and which could contaminate the variable or variables under examination.

Manipulating Schedules of Reinforcement

Another variable that clearly affects the power of reinforcement is the manipulation of schedules of reinforcement. One such study demonstrating this fact was that conducted by Lovitt and Esveldt (1968) in order to examine the effects of a single ratio schedule as opposed to multiple schedules in an academic setting. Single and multiple schedules were alternated in the first experiment. The results demonstrated that during the application of multiple schedules, the S responded at a higher rate.

A second experiment supported the results of the first experiment. In the third experiment, the frequency of reinforcement was controlled. The data showed that alternation had little effect on the Ss response rate. The fourth experiment produced data that supported the findings of the original experiment. These results suggest that once more detailed information is available on the effects of each schedule of reinforcement on humans, then teachers should experiment in the combination of schedules for each child in an individualized curriculum for maximum results.

Orlando and Bijou (1960) conducted an experiment to examine characteristic performances under four basic schedules (VI, FI,

VR, FR) and two multiple schedules (multiple VR extinction and multiple CRF extinction). The Ss were forty-six institutionalized Ss.

The experimenters found that response rate is clearly a function of the kind and value of schedules. In the Ss involved in this experiment, higher rates of responses were realized from lower ratios, longer intervals, and variable rather than fixed schedules.

Morse (1966) states, "Apart from the special theoretical importance of frequency of responding in time, schedules of reinforcement of discrete responses are important because they represent the most intensively studied and best understood body of information on the generation and maintenance of operant behavior. The experiments pertaining to schedules have significance in showing the tremendous range of behaviors that can be produced by schedules, the power of behavioral control induced by schedules, and the intricate relations that exist among the variables controlling behavior" (p. 57). Ferster and Perrott (1968) contend, "although many variables will increase or decrease the frequency of an operant performance, its schedule of reinforcement is one of the major determinants" (p. 281) Reese (1966) states, "There are certain characteristics of responding on each basic schedule, whether the schedule is in effect alone or in combination with others, that have been found to obtain for many species of animals, including man. Furthermore, these characteristics are sufficiently stable so that performance on a given schedule can be used as a baseline to measure the effects of other variables" (p. 16).

Reinforcement and Extinction

The final factor to be considered that is important in determining the effectiveness of reinforcement is the process of extinction. "Extinction is the operation whereby the reinforcing stimuli which have been maintaining a behavior are no longer available"(Tharp and Wetzel, 1969, p. 104). Logan (1969) elaborates on this definition by adding that, "The rate of extinction depends on the distribution of the extinction trials over time. Learning increases more rapidly if the experiences are widely distributed over time; extinction increases rapidly if the nonreinforced experiences are massed so they occur in rapid succession. Spontaneous recovery will, of course, occur but extinction is better accomplished by a series of highly massed episodes than if individual trials are spread out over time" (p. 118).

Lewis (1960) completed a review of the literature on partial reinforcement organized around the major empirical variables that have been investigated in attempts to determine the effects of partial reinforcement on extinction. He concluded that not many experimenters seemed interested in how one variable relates to the other along the major range of both variables. The author states that more research is necessary if the effect of partial reinforcement on extinction is to be determined.

In summary, there are at least three factors that determine the effectiveness of reinforcement in learning, managing of contengencies, manipulation of schedules of reinforcement and the

process of extinction. An examination of these three factors has been incorporated into the present study.

It is partially from a familiarity with such literature as cited above that the present study was prompted. However, the main impetus for the present study has come from eight quarters of college teaching using the operant model without the strict control found in an experimental situation. Even though pupil success was achieved easily, the experimenter wishes to subject his teaching methodology to a tightly controlled experimental analysis so he could examine the effect of schedule change while screening out the uncontrollable variables that penetrate the average classroom.

The setting was selected because of the interest of several graduate students in psychology who acquired the space and experimental chamber for the experiment. The facilities were excellent for this type of research and other facilities of this quality were not available anywhere else at the University. College students were selected as Ss because of their availability and because they were the Ss of the earlier informal research done in the experimental classes.

CHAPTER II

HYPOTHESES AND PROCEDURES

In this chapter the hypotheses tested and the procedures used will be presented.

Hypotheses

The following hypotheses were tested in the present study. They are all stated in the null form.

1. There are no significant differences in correct response frequencies between baseline, CRF and VR5.
2. There are no significant differences in correct response frequencies in the extinction phases after baseline, CRF and VR5.
3. There are no significant differences in accuracy ratios between baseline, CRF and VR5.
4. There are no significant differences in accuracy ratios in the extinction phases after baseline, CRF and VR5.
5. There are no significant differences in celeration ratios between baseline, CRF and VR5.
6. There are no significant differences in celeration ratios in the extinction phases after baseline, CRF and VR5.

Procedures

Subjects

The Ss were four 19 year-old sophomores, males, with an overall grade point average at the University of Florida ranging from 2.1 to 2.5 on a four-point scale. The Ss were randomly selected from a population of sixteen students who met the criteria of being male, aged nineteen to twenty with a grade point average of 2.0 to 2.5. The population of sixteen who met the criteria, including the four randomly selected, were all students enrolled in the experimenter's two courses in human growth and development. All sixteen members of the population were students who volunteered to participate in a quarter-long academic experiment.

The four Ss signed an informal consent form after the contengencies of participating were explained to them, and were randomly assigned to treatments. Official permission was granted by the University of Florida to conduct the experiments on humans after the experimenter petitioned. The project was Number 419 of 1972. (See Appendix A-1.)

The small number of Ss studied is justified by the very nature of operant experimentation. In these experiments, each S emitted responses during a baseline phase which served as the control phase against which experimental phases can be compared. A systematic replication (Sidman, 1960) of the experiment was conducted to establish the reliability and generality of the data. In support of the experimenter's defense of a small number of Ss, Sidman (1960)

states, "It is not true that the larger the group, the greater the generality of the data" (p. 47).

Selecting Curriculum Materials

The performance items were fill-in the blank questions developed from Mussen, Conger and Kagan's text. (See Appendix A-2.) These items were selected from a pool of seven hundred and fifty original items by an informal item analysis over several quarters. Items that were obscured, too easy, or too difficult were eliminated from the items selected to be used in the experiment. Thirty items were selected from each chapter, sixty per unit, making a total of three hundred and sixty for the entire experiment. The performance items were numbered from one to sixty for each unit so that the experimenter could randomly choose items for each day. Items were chosen with the use of a random number table and the order of presentation was the same for all subjects. When an item appeared more than once on the random number table, duplicate items were used. The order of item presentation is in tabular form in Appendix B.

Administering Curriculum Materials

The curriculum was divided into six units, presented to all subjects in the same order, two chapters per week, with performance on the materials covered in the first week, reperformed on in the third week, materials performed on in the fourth week were reperformed on in the sixth week. Materials performed on in the seventh week were reperformed on in the ninth week.

The four subjects emitted verbal responses to performance items during a session which had a maximum duration of five minutes.

Each day prior to the performance sessions, the experimenter randomly selected twenty performance items from the pool of sixty. The Ss reported to a waiting room at fifteen-minute intervals with instructions not to speak with anyone while waiting. The performance sessions started at seven p.m., Monday through Thursday for nine consecutive weeks. Each S had a permanent appointment time for his performance session spaced every fifteen minutes.

Instructions for the experiments were presented on an 8mm color film with a synchronized sound track to minimize any possible variation in delivery. The film was shown to each subject privately in the room where the performance session would take place. The film explained that the Ss were enrolled in a five-hour course; stating that the requirement for a grade of A was to participate in thirty-six consecutive performance sessions, during which they would be expected to respond verbally to twenty performance items. A performance criterion was not set or mentioned. The Ss were told to purchase the text used for the experiment, reading assignments were made for the entire nine-week period, and the Ss were told that they should study as if they were in the regular course. The Ss were given an appointment time for their sessions and shown a filmed performance session taking place in the experimental chamber in which they were expected to perform. (See Figure 1.) They were instructed not to speak with anyone while waiting for a

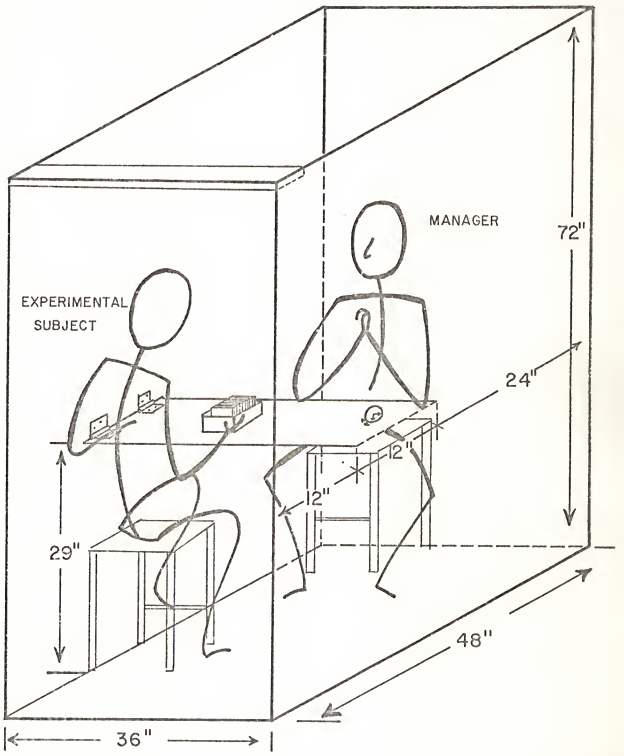

Figure 1. Experimental Chamber

performance session and to be on time for their appointment. The Ss were told that their manager would take them from the waiting room to the experimental chamber for their session. After the session they were to leave the building immediately, returning the following evening at the appointed time.

Two student-managers, both graduate students in psychology with a year of supervised managing experience were employed by the experimenter to conduct the performance sessions. The managers were assigned to the same number of sessions and days to control for any variation in manager performance.

The manager scheduled for the evening, picked up each S at the waiting room, brought him into the room housing the experimental chamber, both entered the chamber and sat down facing each other with the manager's back to the rear wall. (See Figure 1.) The experimenter was sitting in an adjoining room watching the session through a one-way mirror. The manager gave the S a stack of twenty items and told him to start. As the S emitted verbal responses to the performance items, the manager counted the number of correct responses with the use of a wrist counter while the experimenter timed the session with a stopwatch. When the S completed the twenty items or when the five minutes had elapsed, the experimenter sounded a loud buzzer indicating that the session was over.

As the S left, the manager went into the experimenter's room to report the data from the session. The data were recorded at the end of each session on a data sheet (see Appendix C). The date,

duration of the session, number correct, number incorrect, accuracy ratio and the floor were recorded after each session. The data were then charted on standard behavior charts.

The Ss were not aware of what the experimenter was doing other than sounding a buzzer. The Ss did not see their recorded data or charts until after the experiment had been concluded. During the nine-week experimental period the Ss were not allowed to discuss the experiment or ask questions about anything pertaining to the experiment. The Ss were told in the instructional film that, other than social greetings, they were not allowed to speak with the managers or the experimenter during the course of the experiment. If they had any questions about the experiment, the Ss were authorized to ask the manager to show the instructional film again. The managers were instructed not to engage in conversation with the Ss and not to express any positive or negative feedback including facial expressions during or after the performance sessions. These precautions were taken in an attempt to screen out contaminating variables, like social reinforcement through smiles, nods, etc.

Research Design

The research design consisted of an experiment which was systematically replicated in Experiment II. Table I summarizes this design. A systematic replication allows the experiment to compare the findings in a new experiment very similar to findings in the original experiment, when the second findings were obtained under conditions systematically changed. As Sidman (1960) states, "Systematic replication is a time-tested method for

TABLE I

RESEARCH DESIGN

Experiment I

Experiment I with Direct Replication

PHASE I	PHASE II	PHASE II	PHASE IV	PHASE V	PHASE VI
Condition A	Condition A1	Condition B	Condition A2	Condition C	Condition A3
Units I & II Chapters 2, 3, 4 & 5	Unit I Chapters 2 & 3	Units III & IV Chapters 6, 7, 8 & 9	Unit III Chapters 6 & 7	Units V & VI Chapters 10, 11, 12 & 13	Unit V Chapters 10 & 11
Duration Eight days	Duration Four days	Duration Eight days	Duration Four days	Duration Eight days	Duration Four days
Subjects 1 & 3	Subjects 1 & 3	Subjects 1 & 3	Subjects 1 & 3	Subjects 1 & 3	Subjects 1 & 3

Experiment II

Experiment II with Direct Replication

Systematic Replication of Experiment I

PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI
Condition A	Condition A1	Condition C	Condition A3	Condition B	Condition A2
Units I & II Chapters 2, 3, 4 & 5	Unit I Chapters 2 & 3	Units III & IV Chapters 6, 7, 8 & 9	Unit III Chapters 6 & 7	Units V & VI Chapters 10, 11, 12 & 13	Unit V Chapters 10 & 11
Duration Eight days	Duration Four days	Duration Eight days	Duration Four days	Duration Eight days	Duration Four days
Subjects 2 & 4	Subjects 2 & 4	Subjects 2 & 4	Subjects 2 & 4	Subjects 2 & 4	Subjects 2 & 4

increasing both the quantity and the quality of one's work. An original experiment may have been long and arduous. Direct replication would not only occupy a large segment of the experimenter's time but also tie-up costly apparatus that might be used to obtain other important information. On the other hand, systematic replication will buy reliability, generality and additional information" (p. 112).

As can be seen from Table I, Ss 1 and 3 were the Ss of the basic experiment with Ss 2 and 4 being the Ss of the systematic replication. For Ss 1 and 3, the experiment consisted of six phases using three schedules of reinforcement and three extinction phases. Ss 1 and 3 were exposed to no schedule (baseline), extinction, CRF, extinction, VR5 and extinction. Ss 2 and 4 were exposed to no schedule (baseline), extinction, VR5, extinction, CRF and extinction. The order in which the independent variable (the schedule of delivery of a generalized reinforcer) was applied and reversed in the two basic experiments was intended to control for the level of difficulty of the curriculum materials.

The three conditions under which a schedule of delivery of a generalized reinforcer was to be applied were labeled conditions A, B and C. In condition A, no schedule was applied in order to acquire eight days' data for baseline. During condition B, a CRF schedule of delivery of five cents was presented to the S contingent upon the S drawing a starred card from a box in the experimental chamber, after the manager punched his wrist counter indicating the S's verbal response was correct.

Also during condition B, all the cards in the box were starred. Therefore, the subject was reinforced with five cents for each correct response as soon as he pulled the starred card. When the manager saw the starred card he presented five cents. The timer was stopped when the counter was punched. The timer was off while the card was being pulled and while the reinforcer was being delivered. The timer was started when the S started reading the next performance item.

During condition C, a VR5 schedule, the same procedure was followed except that starred cards were programmed so that the subjects only drew starred cards 20 percent of the time. The maximum number of starred cards a subject could draw if he performed at a 90 percent level of accuracy was four. Consequently, the maximum number of reinforcers he could earn was four.

The three extinction conditions were identical, except that condition A, followed baseline, condition A2 followed CRF and condition A3 followed VR5.

As can be seen in Table I, conditions A, B, and C were applied while the subjects were performing on curriculum units I, II, III, IV, V and VI. Conditions A, A2, and A3 were applied while subjects were reperforming on units I, III, and V.

The Ss were not informed about the schedules or when schedules would be in effect. They were not informed about extinction phases. The Ss were advised what to study, when to perform and that sometime during the experiment they would have the opportunity to earn money. During baseline and extinction phases, they were required to pull

cards from the box after each correct response. During those conditions, the cards were always blank. The procedure of pulling cards after a correct response remained constant throughout the experiment.

CHAPTER III

RESULTS

There were six analyses performed on the data collected. Four subject by day by treatment analyses of variance on logs (Base 10) of the data were completed, and two subject by treatment analyses of variance were conducted on celeration ratios.

According to Koenig (1972), "When measuring human frequencies it is to your advantage to log them" (p. 33). An analysis should be done using the logs to insure homogeneity of variance and to encompass the relationships--linearity, symmetry, and additivity--of the logs of the frequencies.

An analysis of variance summary table shows the reader how the design was set up and about the factors under study. For example, as shown in Table II, in the three-way analysis, the effect of treatments and days are both conspicuous (Scheffe, 1959).

The use of analysis of variance in this study was selected before the experiment was conducted. The experimenter decided that the use of the analysis of variance was the most appropriate analysis for his research design, agreeing with Koenig,

TABLE II

SUBJECT BY DAY BY TREATMENT ANALYSIS OF VARIANCE ON LOGS OF CORRECT FREQUENCIES DURING TRAINING

Source	Degrees of Freedom	Sum of Squares	Mean Square	Error Term	F
Subjects	3	.697	.232		
Treatments	2	.075	.038	Subj. X Trts.	.93
Days	7	1.447	.207	Subj. X Days	49.74*
Subject X Trts.	6	.242	.040		
Subject X Days	21	.087	.0042		
Trts. X Days	14	.152	.011	Subj. X Trts. X Days	1.21
Subj. X Trts. X Days	42	.377	.009		

*$p < .01$

that the analysis should be done on the logs of the frequencies for the reasons already cited.

Correct Frequencies During Training

The analysis of the correct frequencies during training as shown in Table II reveals the day effect to be highly significant, $p. < .01$. There were no significant differences between baseline, CRF and VR5, and no day by treatment effect was found. The first null hypotheses was not rejected.

Correct Frequencies During Extinction

As may be seen in Table III, the analysis of correct frequencies during extinction demonstrated days to be significant again, $p < .01$. The correct frequencies decreased on each successive day.

The treatments, baseline, CRF and VR5 did not differe overall, but there was a significant interaction between the treatments and days, $p < .01$. The second null hypothesis was not rejected.

The significance of the interaction between treatments and days indicates that the effect of the treatments was not constant across days. It was observed that baseline decreased going from Day 1 to Day 4, but CRF and VR5 maintained high levels of correct frequencies going from Day 1 to Day 4. In fact, CRF had its highest value on the last day of extinction.

Accuracy Ratios During Training

The analysis of accuracy scores during training as may be seen in Table IV showed the day effect was again significant, $p < .01$. This was exptected since repetition of the performance items tends to

TABLE III

SUBJECT BY TREATMENT BY DAY ANALYSIS OF VARIANCE ON
LOGS OF CORRECT FREQUENCIES DURING EXTINCTION

Source	Degrees of Freedom	Sum of Squares	Mean Square	Error Term	F
Subjects	3	.265	.088		
Treatments	2	.010	.005	Subj. X Trts.	1.44
Days	3	.175	.058	Subj. X Days	11.95*
Subject X Trts.	6	.022	.004		
Subject X Days	9	.044	.005		
Trts. X Days	6	.601	.100	Subj. X Trts. X Days	4.92
Subj. X Trts. X Days	18	.367	.020		

*$p < .01$

TABLE IV

SUBJECT BY DAY BY TREATMENT ANALYSIS OF VARIANCE ON
LOGS OF ACCURACY RATIOS DURING TRAINING

Source	Degrees of Freedom	Sum of Squares	Mean Square	Error Term	F
Subjects	3	3.721	1.240		
Treatments	2	.0562	.0281	Subj. X Trts.	.3286
Days	7	5.836	.8337	Subj. X Days	28.4209*
Subject X Trts.	6	.5127	.0854		
Subject X Days	21	.6160	.0293		
Trts. X Days	14	.5531	.0395	Subj. X Trts. X Days	.7522
Subj. X Trts. X Days	42	2.206	.0525		

*$p < .01$

improve a S's accuracy. The treatments showed no difference in level of accuracy and there was no significant treatment by day interaction. The third null hypotheses was not rejected.

Accuracy Ratios During Extinction

Table V demonstrates extinction accuracy ratios observed after baseline, CRF, and VR5 differed significantly, $p < .01$. Baseline held the highest accuracy score, followed by CRF. VR5 had the lowest accuracy ratio. The day effect was also significant. The accuracy ratios decreased going from Day 1 to Day 4 as was anticipated. There was also a signifi ant day by treatment interaction, $p < .01$. Investigation of the day by treatment interaction showed that accuracy was highest under baseline during Day 1 and Day 2, but fell off rapidly during Day 3 and Day 4. Similarly the accuracy was high during Day 1 and Day 2 for CRF, but was highest at Day 4. VR5 was highest on Day 1, but maintained high levels again on Day 3 and Day 4. These findings suggest that better accuracy over time can be obtained using treatments CRF and VR5. The fourth null hypothesis was rejected.

Celeration Ratios During Training

The celeration ratios were obtained from the lines best fit to the data using the least square technique (Ferguson, 1959). The lines were fitted to the log base 10 of the frequencies correct and frequencies incorrect (Koenig, 1972). The celeration of the line for frequency correct was computed by taking the ratio of the computed value of day (i + 7) to day i using the lines of best fit. Then the celeration ratio was the ratio of the

TABLE V

SUBJECT BY TREATMENT BY DAY ANALYSIS OF VARIANCE ON LOGS OF ACCURACY RATIOS DURING EXTINCTION

Source	Degrees of Freedom	Sum of Squares	Mean Square	Error Term	F
Subjects	3	2.289	.7631		
Treatments	2	.6292	.3146	Subj. X Trts.	30.1070*
Days	3	1.155	.3850	Subj. X Days	9.6340**
Subject X Trts.	6	.0627	.0104		
Subject X Days	9	.3597	.03997		
Trts. X Days	6	3.405	.5675	Subj. X Trts. X Days	6.9697***
Subj. X Trts. X Days	18	1.466	.0814		

*$p < .01$
**$p < .01$
***$p < .01$

celeration for frequency correct over the celeration for frequency incorrect. The analysis of celeration ratios during training as seen in Table VI, showed no differences between the treatments. The celeration ratio was highest for CRF, then baseline, with VR5 last. The fifth null hypotheses was not rejected.

Celeration Ratios During Extinction

The analysis of variance as illustrated in Table VII showed that baseline, CRF and VR5 differed slightly, $p < .10$. The means for baseline, CRF and VR5 respectively are, .002188, 12.5991 and .959485. The sixth null hypothesis was not rejected.

TABLE VI

SUBJECT BY TREATMENT ANALYSIS OF VARIANCE
ON CELERATION RATIOS DURING TRAINING

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Subjects	3	1.046	.3487	
Treatments	2	.3927	.1963	.5768
Subj. X Trts.	6	2.0419	.3403	

TABLE VII

SUBJECT BY TREATMENT ANALYSIS OF VARIANCE
ON CELERATION RATIOS DURING EXTINCTION

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Subjects	3	124.489	41.496	
Treatments	2	393.4389	196.719	4.735*
Subj. X Trts.	4	249.264	41.544	

$p < .10$

CHAPTER IV

DISCUSSION AND CONCLUSIONS

The data from this study present several interesting comparisons to the body of animal literature for the past twenty years. However, since the greatest part of animal literature reports stable states of responding on simple behaviors without the secondary reinforcing properties in the educational system set up by the culture, the comparison is limited. The present experiments compared transition states during training and extinction. Another serious limitation is that most animal data show both between and within session analysis, while the experiments reported here do not. The experimenter's resources did not permit detailed within session recording and continuous analysis of the Ss' performances.

The findings of the correct frequency analysis as seen in Figure 2 during baseline demonstrate that secondary reinforcement for emitting correct verbal responses in an educational setting is ubiquitous in our culture. Historically in American education, students have been rewarded by teachers, peers and parents for being correct and for obtaining good grades. In constrast, the operant level of responding (baseline) is low in animal experimentation because reinforcement of any type is screened out. Even though the secondary reinforcement provided by our culture did make our baseline phase dissimilar from baseline phases with lower organisms, the contaminating secondary reinforcing effect was constant throughout all

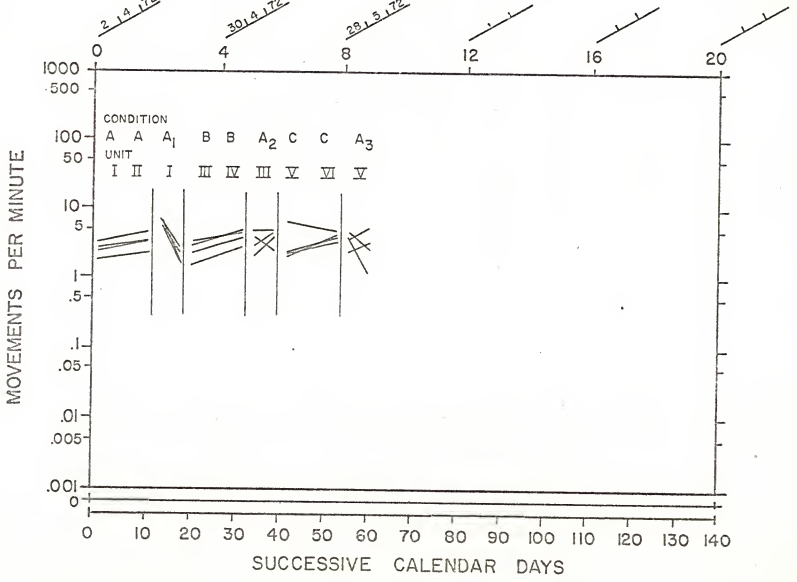

Figure 2. Frequency Correct Celeration Summary--All Subjects

phases of the experiment, and was thereby controlled. The highly significant day effect, $p < .01$, shown in Table II, was probably due to the repetition of material over the experimental periods. Future experimenters with this design should plan for a large pool of performance items. This would reduce the day effect while sharpening the focus on treatments.

During the extinction phase after baseline, the secondary reinforcing effect of the instruction film was evident as the Ss anticipated monetary reinforcement as demonstrated by high initial correct frequencies. When the monetary reinforcement was not delivered, correct frequencies dropped rapidly. There data are similar to findings in the animal literature which show that when conditions of extinctions are presented, rate of responding drops off dramatically.

The Ss were told in the film that they would get the opportunity to earn money sometime during the experiment. The Ss advised the experimenter after the experiments were concluded that they anticipated that the monetary reinforcement was going to be delivered in the third week. When they were re-presented with material from Unit I and no monetary reinforcement occurred, responding decelerated.

During the continuous reinforcement (CRF) phase, as seen in Figure 2, the analysis reveals a steady rise in frequency of correct responses over the eight performance sessions. This finding corresponds well to the animal literature where an organism under CRF conitions will show a steady increase in rate of responding untilhe reaches a terminal rate of responding under this condition

(Skinner, 1938 and Merbitz, 1970). At the end of this phase Ss were still accelerating in frequency correct, indicating that a terminal rate had not been reached. The lines of best fit in Figure 2 also reveal that during extinction after continuous reinforcement (CRF) all the relevant variables were not under experimental control, as only one S showed the rapid drop-off in frequency correct as expected from the findings in animal literature (Ferster and Skinner, 1957). However, this suggests that the treatment (CRF) had a beneficial effect on retention of academic content acquired during training. This finding should be of great interest to teachers and administrators.

During the variable ratio (VR5) phase, graphically shown in Figure 2, the data again suggest that all the relevant variables were not under experimental control as the trend for one S differed from the other three. Three of the Ss showed a rise in frequencies over the course of the phase. Variable ratio performance in animal experiments is characterized by a high steady rate of responding once a stable state is reached. Figure 2 shows that the Ss did not reach a stable state due to time limitations inherent in the quarter system. The highest individual frequency correct observed in the experiment was obtained during this phase, it correspondence with the animal literature (Ferster and Skinner, 1957). However, the S who obtained this high frequency is also the S who differed from the other three Ss in that his frequencies correct dropped steadily throughout the course of the phase. Two incidents which happened during this condition, which were not under experimental control and had not been anticipated, were beer drinking by one S during

three performance sessions and facial injury to another S just before his performance session.

The summary chart (Figure 2) shows that in the extinction phase following the variable ratio phase, variables that were not controlled by the experimenter affected the performances. This can be seen clearly, as the slopes of the line of best fit for two Ss are opposed to the lines of best fit for the other two Ss. Findings from animal experiments suggest that all Ss should have dropped off in frequency correct during this phase as well as the two previous extinction phases. The reason for this is that the probability of future responding decreases when a response is not followed by a reinforcement. However, with these Ss it seems clear that, in general, like CRF, VR5 maintained high levels of frequencies correct, which supports the earlier findings that after CRF the treatments had a beneficial effect on retention of academic content acquired during training.

The maintenance of high frequencies during VR5 has special significance for administrators and teachers. This finding suggests that similar effective results can be obtained more efficiently, i.e., at less cost, on a VR schedule. During the last two evenings of the performance session the Ss were jubilant that the experiment was about to end. They demonstrated this with high frequencies during extinction. They stated after the experiment was over that performing in thirty-six evening sessions had seriously affected their social lives and they were happy to be free again. They indicated they enjoyed participating in the experiment but were glad to have it behind them.

Inspection of the summary chart for frequency correct (Figure 2), revealed that the secondary reinforcement in baseline, the secondary reinforcement plus CRF and the secondary reinforcement plus VR5 had differential effects on the extinction phases. Over the three extinction phases, behavior came less and less under experimental control as the frequencies of correct responses became more heterogenous. The FI effects of the quarter may have contributed to this lack of experimental control, as revealed by the extinction data as the superordinate schedule took effect (Pennypacker et al., 1969).

The summary celeration chart of incorrect frequencies as seen in F'gure 3 was not analysed because it was not proposed at the outset on the experiment. However, a visual inspection of the summary chart indicates that the heterogeneity of extinction effects starts in the first extinction phase and become more pronounced in the second extinction phase. This finding calls for further research in that it implies that the frequency incorrect is more sensitive than frequency correct to other variables during extinction.

The summary chart of accuracy ratios (Figure 4) is similar to the summary chart of frequency correct in terms of the heterogeneity of effects during extinction.

The summary chart of celeration ratios as seen in Figure 5 indicates that after non-contingent academic performances, retention falls off rapidly, while after contingent learning retention remains high. This is demonstrated by low celeration ratios after baseline and higher celeration ratios after CRF and VR5.

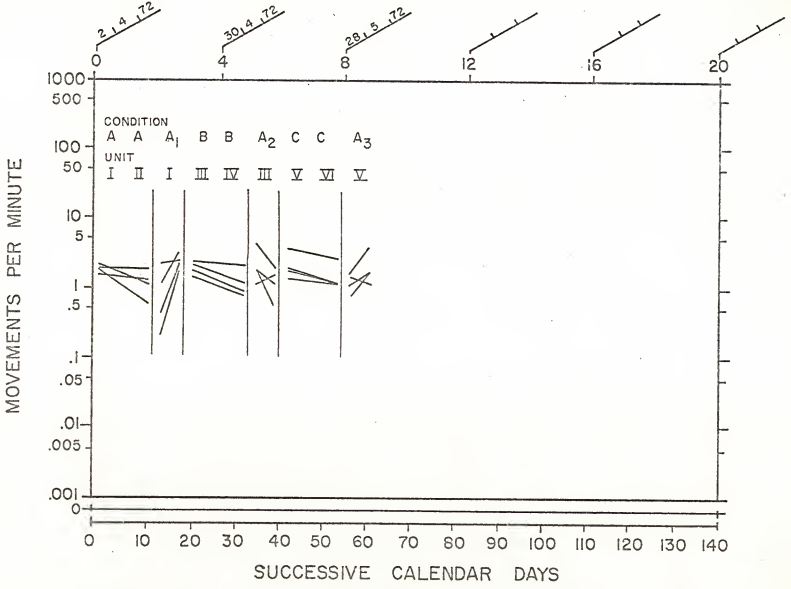

Figure 3. Frequency Incorrect Celeration Summary--All Subjects

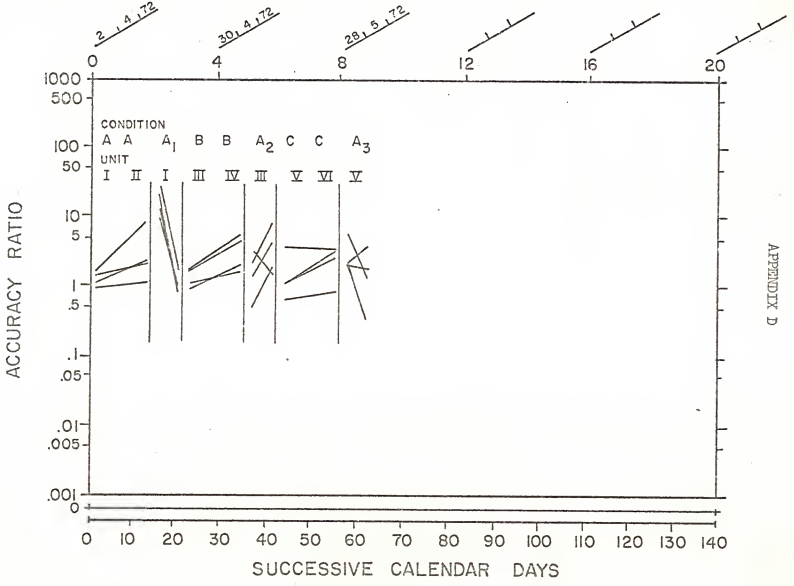

Figure 4. Accuracy Summary Chart--All Subjects

APPENDIX D

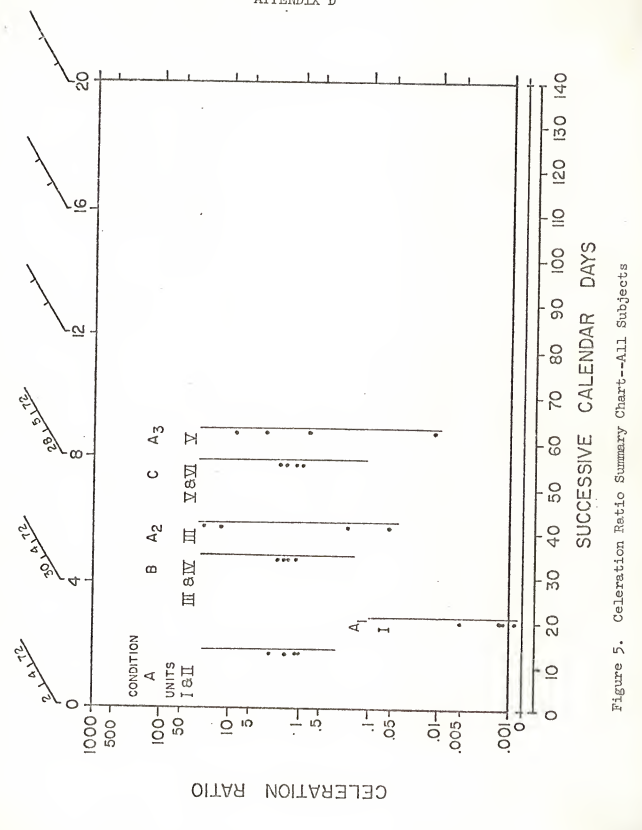

Figure 5. Celeration Ratio Summary Chart--All Subjects

Another point that should be mentioned is that in these data treatment effects are not prominent until extinction. In contrast, schedule shifts can sometimes be seen during treatments in experiments with lower organisms, although longer session length make these data hard to compare.

In the experimenter's opinion the most serious limitation of the experiment was the FI properties of the quarter system which seemed to introduce other effects into the experiment that could not be controlled because of cultural restrictions. The time limitation of the quarter did not allow the experimenter to let the Ss reach a steady frequency of responding before making phase changes (Sidman, 1960). However, it is comforting to realize that even in a tighly controlled experimental design, the cultural influences of a democratic society are so internalized in the Ss that they prevent he Ss from coming under the total control of the experimenter. As Skinner states, "A scheduling system has no effect until an organism is exposed to it, and then it no longer determines the contengencies" (Skinner, 1966, p. 26).

Suggestions for Further Research

The findings of this study clearly suggest that further research should be conducted using the operant model in academic settings to determine the feasibility of different variable schedules of reinforcement for educators in elementary, secondary and higher education. The implications derived from this study are that the employment of VR schedules in education at every level would make: (1) the educational process less costly to the taxpayer; (2) less time consuming for the teacher; and (3) more meaningful for the student, as demonstrated in

Figure 2 by higher frequencies correct during extinction after contingent learning on a VR5 schedule than after non-contingent learning.

As mentioned earlier, it is also suggested that future researchers use a larger pool of performance items to sharpen the focus on the treatment effects while reducing the day effect.

Last but not least, researchers using the operant model in an academic setting should control for the FI properties of the quarter, semester or trimester system by arranging for Ss to enroll in open-ended research courses without rigid time limits.

Now that the initial data on paying students directly for engaging in the learning process at the university level has demonstrated the feasibility of such an approach, it is this experimenter's hope that future researchers will conduct similar experiments in the elementary and secondary schools in the ghettos of this nation. The experimenter feels that the findings from future research using monetary reinforcement in ghetto schools could significantly reduce the drop-out problem so rampant in this country.

Conclusions

It seems to the experimenter, that for college teaching, an instructor who is primarily concerned with retention or future use of academic material, should consider using contingent reinforcement schedules specifically tailored to the individual, in addition to the contingencies built in by the culture. For elementary and secondary schools, administrators and teachers should immediately

explore the possibilities inherent in the use of the operant model for the benefit of potential drop-outs and for the sake of the taxpayers.

In closing, I would like to agree with and quote two distinguished educational psychologists who state, "humanism, behaviorism, the student and the teacher can and should act as a well organized cooperative team that is playing the game for the common purpose of making the learning process as meaningful, useful, and successful as possible" (Avila and Purkey, 1971, p. 116).

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APPENDICES

APPENDIX A

SAMPLE FORMS

APPENDIX A-1

INFORMED CONSENT FORM

Subject's Name:

Address:

Title of Project:

Project Number:
Principal Investigator:

I, the undersigned, do understand the purpose of the above investigation project. The study proposed has been defined and explained to me by the investigator whose name is signed below, and I agree to participate in this study, or to have my minor child, ward, whose name is _____ _____ participate in this study.

_____ _____
Subject's Signature Date

_____ _____
Signature of parent or guardian, if subject is a minor (where applicable) Date

I, the undersigned, have defined and explained this study to the volunteer.

_____ _____
Investigator's Signature Date

_____ _____
Witness Date

APPENDIX A-2

SAMPLE PERFORMANCE ITEMS

(1) The largest cell in the human body is the ___(OVUM)_____.

(2) The most serious threat to the newborn during the birth process is lack of adequate _____(OXYGEN)_____.

(3) The elementary principles of gene interaction were first worked out by an Austrian monk, __(MENDEL)_____.

(4) There are several genetically determined disorders that lead to gross defects or ___(DETERIORATION)_____ in intelligence.

(5) If there are genetically determined differences between the blood types of the fetus and its mother, they may be (BIOCHEMICALLY) _____ incompatible.

(6) There is support for the hypothesis that severe malnutrition of a pregnant mother may cause _____(RETARDATION)_____ in her child.

(7) The period of the embryo is characterized by an extremely rapid development of the __(NERVOUS)_____ system.

(8) A gene is composed of a chemical called __(DNA)____.

APPENDIX B

TABLES OF RANDOMIZED ORDER OF PRESENTATION OF PERFORMANCE ITEMS

APPENDIX B

TABLE VIII

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 1, UNIT I
CHAPTERS 2 AND 3, CONDITION A

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	34	07	25	05
2	45	32	47	53
3	02	01	08	29
4	05	50	21	17
5	03	15	57	02
6	14	14	54	35
7	39	48	02	31
8	06	58	56	34
9	17	54	05	48
10	26	40	45	36
11	11	53	19	18
12	16	21	37	03
13	01	37	04	23
14	20	24	52	49
15	19	59	24	42
16	36	55	53	46
17	52	42	51	13
18	37	41	06	07
19	15	04	14	38
20	07	46	49	06

APPENDIX B

TABLE IX

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 2, UNIT II
CHAPTERS 4 AND 5, CONDITION A

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	03	01	09	33
2	53	47	54	05
3	07	50	42	53
4	40	27	01	29
5	18	18	06	17
6	09	16	26	02
7	60	54	52	35
8	35	56	45	31
9	42	22	48	16
10	24	56	48	16
11	49	03	12	03
12	20	07	33	12
13	44	40	10	40
14	43	09	55	51
15	38	60	19	59
16	22	35	49	45
17	52	42	45	15
18	08	24	23	43
19	15	49	47	20
20	47	20	46	11

APPENDIX B

TABLE X

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 3, UNIT I
CHAPTERS 2 AND 3, CONDITION A1

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	10	20	25	29
2	08	26	48	17
3	09	57	47	05
4	12	01	08	02
5	31	33	21	35
6	11	50	57	53
7	44	29	54	31
8	15	54	02	34
9	42	46	05	48
10	23	11	45	03
11	04	43	19	23
12	35	09	37	49
13	32	32	04	42
14	19	48	52	46
15	45	07	24	13
16	54	44	53	54
17	01	37	51	07
18	06	35	14	36
19	26	31	49	30
20	57	51	33	38

APPENDIX B

TABLE XI

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 4, UNIT III
CHAPTERS 6 AND 7, CONDITIONS B AND C

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	19	20	26	33
2	09	31	57	05
3	34	03	01	53
4	45	30	33	29
5	02	55	50	17
6	05	10	29	05
7	03	04	54	02
8	14	32	46	35
9	39	23	11	31
10	06	42	43	34
11	17	16	09	48
12	14	29	32	03
13	26	21	48	23
14	11	36	07	49
15	16	11	44	42
16	01	35	37	46
17	20	28	35	13
18	52	41	31	54
19	37	08	46	07
20	07	37	51	36

APPENDIX B

TABLE XII

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 5, UNIT IV
CHAPTERS 8 AND 9, CONDITIONS B AND C

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	25	05	01	43
2	48	02	47	38
3	47	35	50	22
4	08	53	27	34
5	21	31	18	24
6	57	34	16	23
7	54	48	54	36
8	02	17	56	35
9	56	03	22	23
10	05	23	03	45
11	45	49	07	43
12	19	42	09	46
13	04	29	60	32
14	52	46	35	12
15	24	13	42	40
16	53	54	07	51
17	14	07	24	59
18	33	35	49	54
19	29	06	20	16
20	17	30	44	33

APPENDIX B

TABLE XIII

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 6, UNIT III
CHAPTERS 6 AND 7, CONDITIONS A2 AND A3

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	09	19	48	05
2	54	09	07	02
3	42	34	32	35
4	01	45	01	53
5	06	02	50	31
6	26	05	15	34
7	57	03	14	48
8	52	14	58	17
9	45	39	54	03
10	59	06	40	23
11	48	37	53	49
12	12	17	21	42
13	35	14	37	29
14	49	26	24	46
15	33	11	59	13
16	10	16	54	17
17	55	26	42	54
18	60	01	41	07
19	19	20	04	36
20	47	19	46	06

APPENDIX B

TABLE XIV

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 7, UNIT V
CHAPTERS 10 AND 11, CONDITIONS B AND C

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	31	33	20	03
2	34	05	24	15
3	48	53	05	47
4	35	29	42	50
5	17	17	39	06
6	03	23	37	48
7	05	02	11	07
8	23	35	47	32
9	49	31	16	01
10	42	34	01	16
11	29	48	47	14
12	46	03	50	58
13	13	49	27	54
14	54	42	18	40
15	07	28	16	53
16	36	46	54	21
17	06	13	56	37
18	30	54	27	24
19	38	07	44	59
20	19	36	43	42

APPENDIX B

TABLE XV

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 8, UNIT VI
CHAPTERS 12 AND 13, CONDITIONS B AND C

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	45	57	19	07
2	59	01	09	57
3	48	33	34	05
4	12	50	45	32
5	35	29	02	52
6	49	54	05	28
7	33	46	03	50
8	10	11	14	51
9	55	43	39	46
10	60	09	06	40
11	19	32	17	25
12	47	48	26	22
13	52	07	11	47
14	54	44	16	15
15	05	37	01	10
16	17	35	20	50
17	23	31	36	45
18	15	46	52	27
19	20	54	37	34
20	26	51	15	20

APPENDIX B

TABLE XVI

RANDOMIZED ORDER OF PRESENTATION
OF PERFORMANCE ITEMS: NUMBERS 1-60

WEEK NUMBER 9, UNIT V
CHAPTERS 10 AND 11, CONDITIONS A2 AND A3

Performance Item Nos.	Monday	Tuesday	Wednesday	Thursday
1	08	05	34	20
2	12	32	24	31
3	31	52	23	03
4	11	28	38	30
5	30	50	36	55
6	09	51	35	10
7	44	46	22	04
8	15	40	50	23
9	42	25	13	42
10	23	22	31	16
11	04	47	58	29
12	35	15	45	21
13	46	10	43	36
14	32	50	32	11
15	19	45	46	35
16	45	27	13	60
17	09	34	40	28
18	54	20	51	41
19	01	24	59	17
20	06	42	54	06

APPENDIX C

TABLES OF INDIVIDUAL DATA SHEETS

TABLE XVII

DATA SHEET

NAME MARSHALL

DATE	TIME	# COR.	# INC.	RATE C.	RATE I.	A.R.	FLOOR	NOTES
4-3	4.00	9	11	2.25	2.7	.833	.25	
4-4	3.5	14	6	4.0	1.7	2.35	.29	
4-5	3.75	15	5	4.0	1.3	3.07	.27	
4-6	4.	18	2	4.5	.5	9.00	.25	
4-10	4.75	14	6	2.94	1.26	2.33	.28	
4-11	4.0	17	3	4.25	.75	5.66	.25	
4-12	4.25	16	4	3.76	.94	4.0	.24	
4-13	3.25	19	1	5.8	.31	19.0	.31	
4-17	3.5	20	0	5.7	.29	19.65	.29	
4-18	3.5	20	0	5.7	..29	19.65	.29	
4-19	3.75	16	4	4.3	1.1	4.0	.27	
4-20	4.75	12	8	2.52	1.68	1.5	.21	
4-24	4.0	7	13	1.75	3.25	.54	.25	
4-25	4.0	15	5	3.75	1.25	3.00	.25	
4-26	3.75	13	7	3.4	1.8		.27	
4-27	3.0	19	1	6.3	.33	19.0	.33	
5-1	4.5	14	6	3.11	1.3	2.33	.22	
5-2	4.5	16	4	3.55	.88	4.0	.22	
5-3	3.75	15	5	4.0	1.3	3.0	.27	
5-4	3.0	18	2	6.0	.66	9.0	.33	
5-8	3.0	15	5	5.0	1.6	3.0	.33	
5-9	3.5	17	3	4.8	.86	5.67	.29	
5-10	4.0	11	9	2.75	2.25	1.22	.25	
5-11	3.0	19	1	6.3	.33	19.0	.33	
5-15	2.75	17	3	6.1	1.09	5.67	.36	
5-16	2.5	16	4	6.4	1.6	4.0	.40	
5-17	2.75	15	5	5.45	1.81	3.0	.36	
5-18	2.5	17	3	6.8	1.2	5.67	.40	
5-22	3.75	12	8	3.2	2.1	1.5	.27	
5-23	3.75	12	8	3.2	2.1	1.5	.27	
5-24	3.5	14	6	4.0	1.7	2.33	.29	
5-25	2.25	19	1	8.4	.44	19.0	.44	
5-29	3.5	15	5	4.3	1.4	3.0	.29	
5-30	4.0	13	7	3.25	1.75	1.86	.25	
5-31	3.75	16	4	4.3	1.1	4.0	.27	
6-1	3.0	16	4	5.3	1.3	4.0	.33	

DATA SHEET

NAME MARC

DATE	TIME	#COR.	#INC.	RATE C.	RATE I.	A. R.	FLOOR	NOTES
4-3	5	9	11	1.8	2.2	.818	.20	
4-4	4	15	5	3.75	1.25	3.0	.25	
4-5	4	11	9	2.75	2.25	1.22	.25	
4-6	4.5	11	9	2.44	2.0	1.22	.22	
4-10	5	11	9	2.20	1.80	1.22	.20	
4-11	5	13	7	2.6	1.4	1.86	.20	
4-12	4.75	13	7	2.73	1.47	1.86	.21	
4-13	4	17	3	4.25	.75	5.67	.25	
4-17	4.5	19	1	4.22	.22	19.0	.22	
4-18	3.75	18	2	4.8	.53	9.0	.27	
4-19	4.75	14	6	2.94	1.26	2.33	.21	
4-20	5.0	9	11	1.8	2.2	.82	.20	
4-24	5.0	6	14	1.2	2.8	.43		
4-25	5.0	12	8	2.4	1.6	1.5	.20	
4-26	4.5	11	9	2.44	2.0	1.22	.22	
4-27	4.25	15	5	3.5	1.17	3.0	.24	
5-1	5	8	12	1.6	2.4	.67	.20	
5-2	5	10	10	2.0	2.0	1.0	.20	
5-3	4.5	14	6	3.11	1.3	2.33	.22	
5-4	4.0	16	4	4.0	1.0	4.0	.25	
5-8	3.75	15	5	4.0	1.3	3.0	.27	
5-9	4.0	16	4	4.0	1.0	4.0	.25	
5-10	4.25	10	10	2.35	2.35	1.0	.24	
5-11	4.5	14	6	3.11	1.3	2.33	.22	
5-15	4.5	10	10	2.22	2.22	1.0	.22	
5-16	4.25	13	7	3.05	1.64	1.86	.24	
5-17	4.0	12	8	3.0	2.0	1.5	.25	
5-18	4.0	15	5	3.75	1.25	3.0	.25	
5-22	5.0	11	9	2.2	1.8	1.22	.20	
5-23	4.5	11	9	2.44	2.0	1.22	.22	
5-24	4.25	16	4	3.76	.94	4.0	.24	
5-25	3.0	17	3	5.6	1.0	5.67	.33	
5-29	4.0	16	4	4.0	1.0	4.0	.25	
5-30	5.0	10	10	2.0	2.0	1.0	.20	
5-31	4.25	12	8	2.5	1.8	1.5	.24	
6-1	3.25	15	5	4.6	1.5	3.0	.31	

DATA SHEET

NAME HOWARD

DATE	TIME	# COR.	# INC.	RATE C.	RATE I.	A.R.	FLOOR	NOTES
4-3	5	12	8	2.4	1.6	1.5	.20	
4-4	4.5	13	7	2.9	1.5	1.86	.22	
4-5	4	13	7	32.5	1.75	1.86	.25	
4-6	4	16	4	4.0	1.0	4.0	.25	
4-10	5	6	14	1.2	2.8	.43	.20	
4-11	4	14	6	3.5	1.5	2.33	.25	
4-12	4.25	14	6	3.29	1.41	2.33	.24	
4-13	3.5	17	3	4.8	.86	5.67	.29	
4-17	3.75	18	2	4.8	.53	9.0	.27	
4-18	3.5	18	2	5.1	.57	9.0	.29	
4-19	3.75	16	4	4.3	1.1	4.0	.27	
4-20	5.0	7	13	1.4	2.6	.54	.20	
4-24	4.75	7	13	1.47	2.73	.54	.21	
4-25	4.75	14	6	2.94	1.26	2.33	.21	
4-26	4.25	12	8	2.8	1.8	1.5	.24	
4-27	3.75	14	6	3.7	1.6	2.33	.27	
5-1	4.75	15	5	3.15	1.05	3.0	.21	
5-2	4.0	15	5	3.75	1.25	3.0	.25	
5-3	4.0	12	8	3.0	2.0	1.5	.25	
5-4	4.0	15	5	3.75	1.25	3.0	.25	
5-8	3.5	17	3	4.8	.86	5.67	.29	
5-9	3.75	17	3	4.5	.80	5.67	.27	
5-10	4.75	11	9	2.31	1.89	1.22	.21	
5-11	3.75	14	6	3.7	1.6	2.33	.27	
5-15	5.0	12	8	2.4	1.6	1.5	.20	
5-16	4.5	15	5	3.33	1.11	3.0	.22	
5-17	3.75	13	7	3.4	1.8	1.86	.27	
5-18	3.0	17	3	5.6	1.0	5.67	.33	
5-22	4.25	13	7	3.05	1.64	1.56	.24	
5-23	4.25	11	9	2.58	2.11	1.22	.24	
5-24	4.0	15	5	3.75	1.25	3.0	.25	
5-25	3.0	19	1	6.3	.33	19.0	.33	
5-29	3.5	14	6	4.0	1.7	2.33	.29	
5-30	4.75	10	10	2.1	2.1	1.0	.21	
5-31	4.25	16	4	3.76	.94	4.0	.24	
6-1	3.0	10	4	5.3	1.3	4.0	.33	

DATA SHEET

NAME STEVE

DATE	TIME	# COR.	# INC.	RATE C.	RATE I.	A. R.	FLOOR	NOTES
4-3	4.5	4	16	.88	3.5	2.5	.22	
4-4	5.0	14	6	2.8	1.20	2.33	.20	
4-5	4.25	13	7	3.05	1.64	1.86	.24	
4-6	4.5	13	7	2.88	1.55	1.86	.22	
4-10	5.0	5	15	1.0	2.0	.33	.20	
4-11	4.5	8	12	1.77	2.66	.67	.22	
4-12	4.5	10	10	2.22	2.22	1.0	.22	
4-13	4.0	15	5	3.75	1.25	3.0	.25	
4-17	3.75	16	4	4.3	1.1	4.0	.27	
4-18	3.5	14	6	4.0	1.7	2.33	.29	
4-19	3.75	14	6	3.7	1.6	2.33	.27	
4-20	3.75	5	15	1.3	4.0	.33	.27	
4-24	3.75	7	13	1.8	3.4	.54	.27	
4-25	3.25	8	12	2.5	3.7	.67	.31	
4-26	3.0	9	11	3.0	3.7	.82	.33	
4-27	3.0	11	9	3.7	3.0	1.22	.33	
5-1	4.0	7	13	1.75	3.25	.54	.25	
5-2	3.5	9	11	2.5	3.1	.82	.29	
5-3	3.25	7	13	2.2	4.0	.54	.31	
5-4	3.75	12	8	3.2	2.1	1.5	.27	
5-8	3.75	13	7	3.4	1.8	1.86	.27	
5-9	3.75	12	8	3.2	2.1	1.5	.27	
5-10	3.75	8	12	2.1	3.2	.67	.27	
5-11	3.75	5	15	1.3	4.0	.33	.27	
5-15	4.5	9	11	2.0	2.44	.82	.22	
5-16	4.25	11	9	2.58	2.11	1.22	.24	
5-17	3.5	11	9	3.1	2.5	1.22	.29	
5-18	3.0	14	6	4.6	2.0	2.33	.33	
5-22	4.25	9	11	2.11	2.58	.82	.24	
5-23	4.0	13	7	3.25	1.75	1.86	.25	
5-24	3.25	13	7	4.0	2.2	1.86	.31	
5-25	3.0	13	7	4.3	2.3	1.86	.33	
5-29	3.25	10	10	3.0	3.0	1.0	.31	
5-30	3.5	6	14	1.7	4.0	.43	.29	
5-31	3.25	8	12	2.5	3.7	.67	.31	
6-1	3.0	16	4	5.3	1.3	4.0	.33	

APPENDIX D

GRAPHIC DATA SUMMARIES

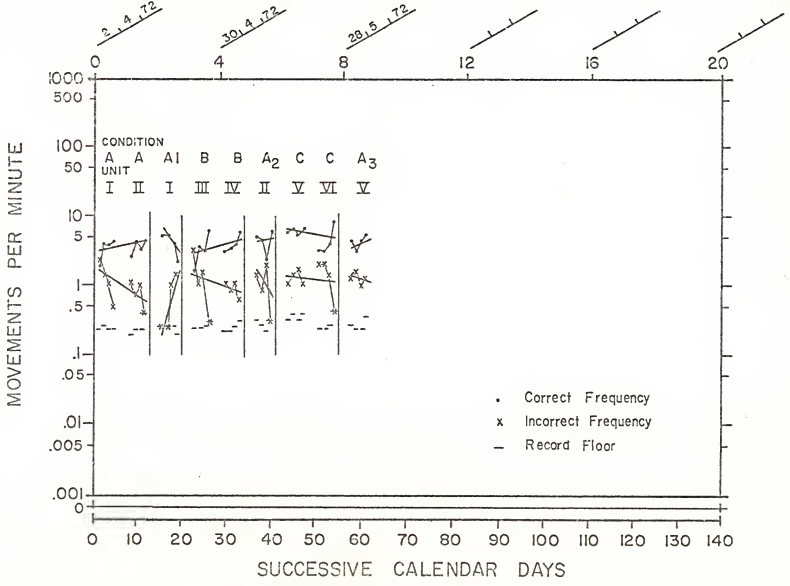

Figure 6. Marshall's Frequency Chart

APPENDIX D

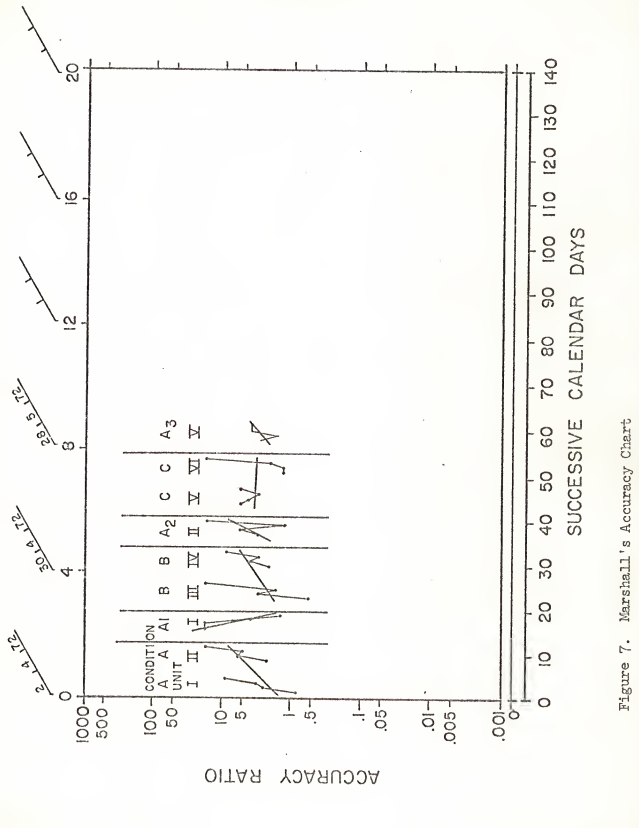

Figure 7. Marshall's Accuracy Chart

APPENDIX D

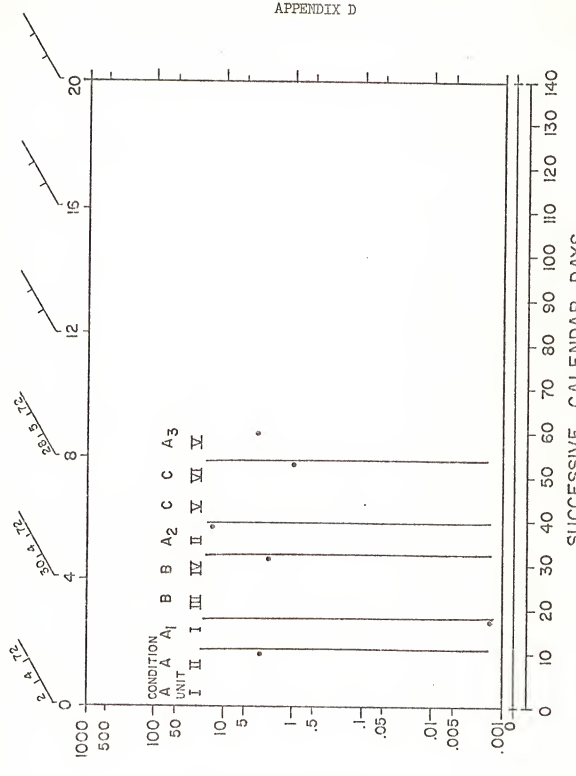

Figure 8. Marshall's Celeration Ratio Chart

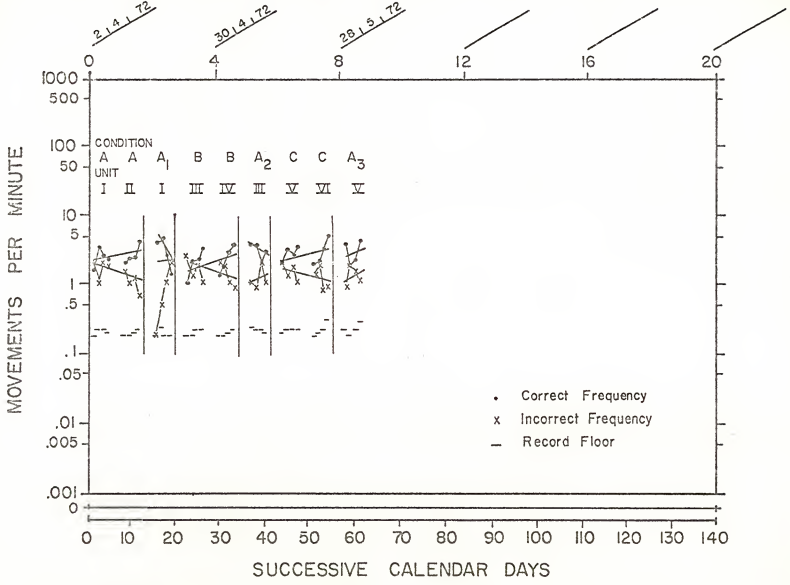

Figure 9. Marc's Frequency Chart

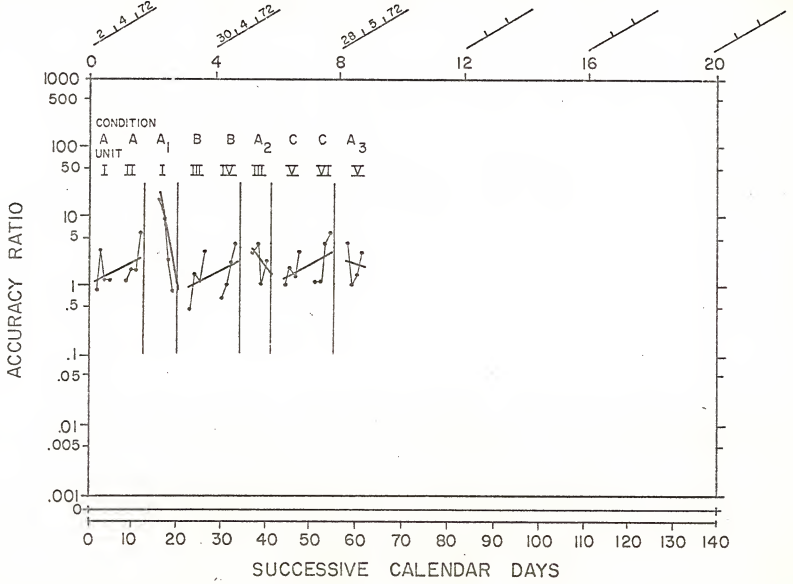

Figure 10. Marc's Accuracy Chart

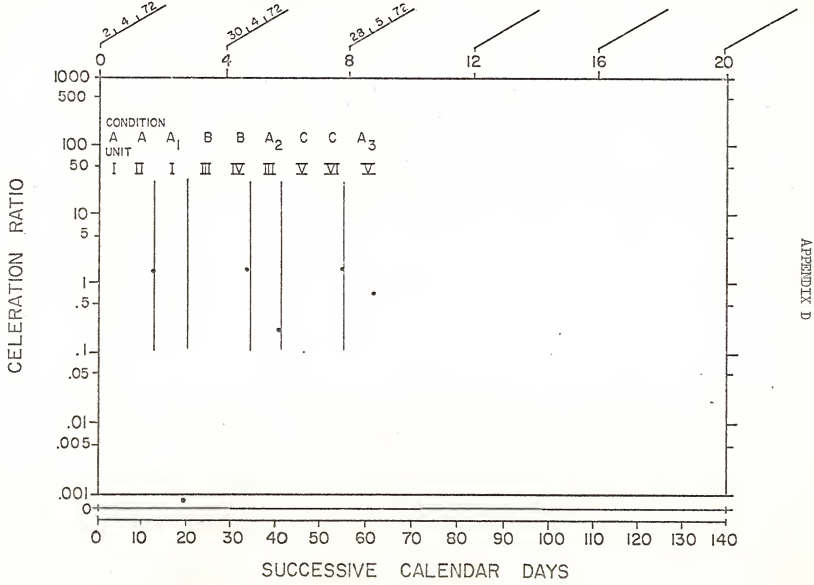

Figure 11. Marc's Celeration Ratio Chart

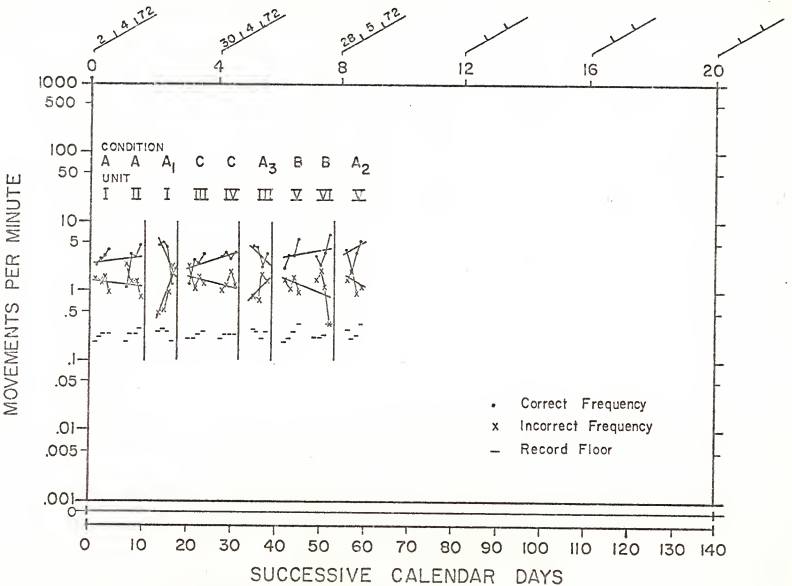

Figure 12. Howard's Frequency Chart

APPENDIX D

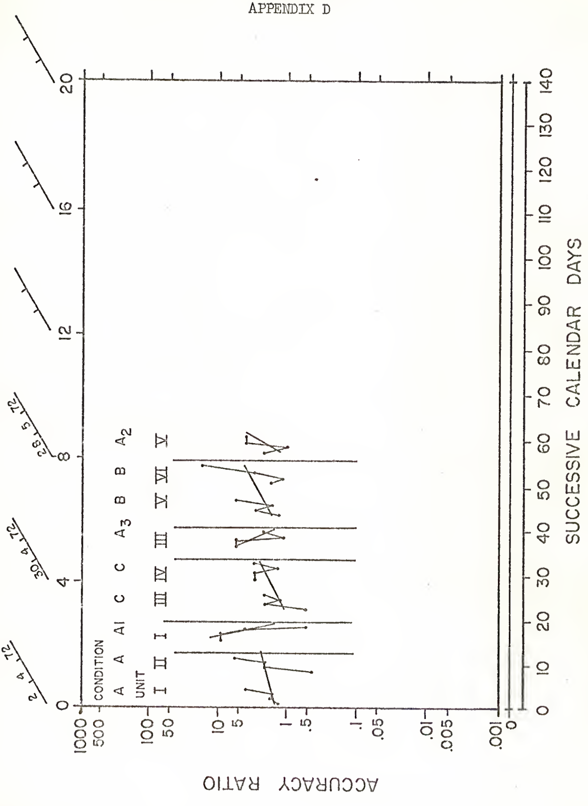

Figure 31. Howard's Accuracy Chart

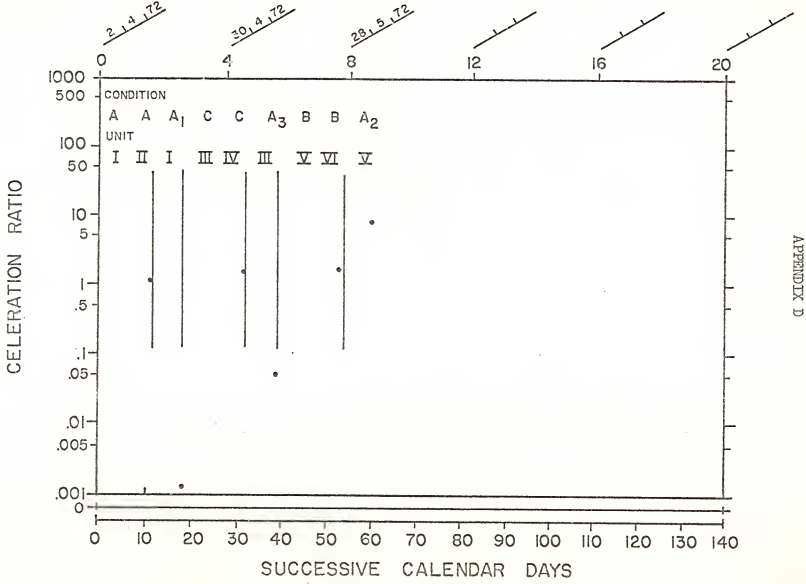

Figure 14. Howard's Celeration Ratio Chart

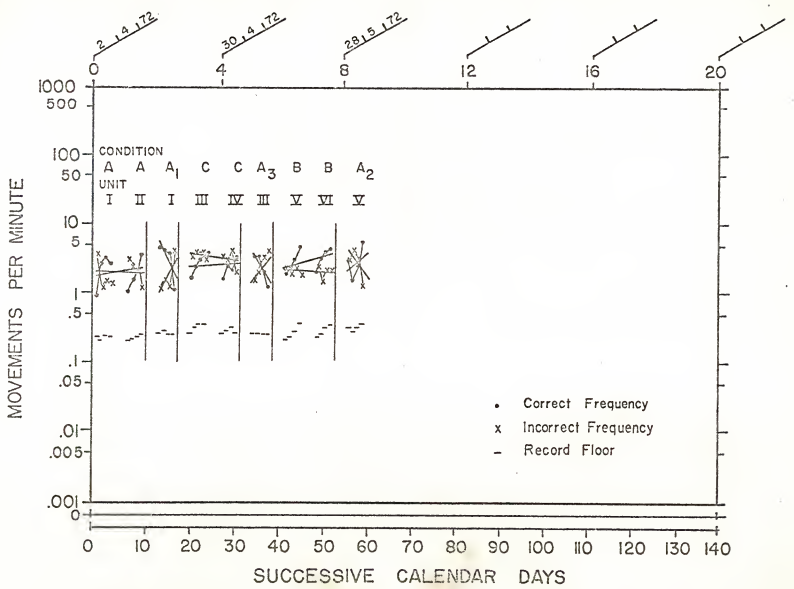

Figure 15. Steve's Frequency Chart

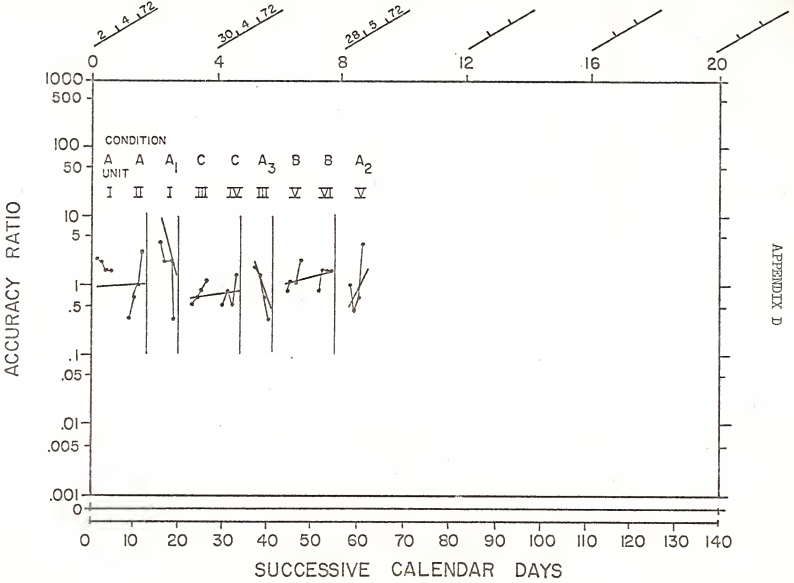

Figure 16. Steve's Accuracy Chart

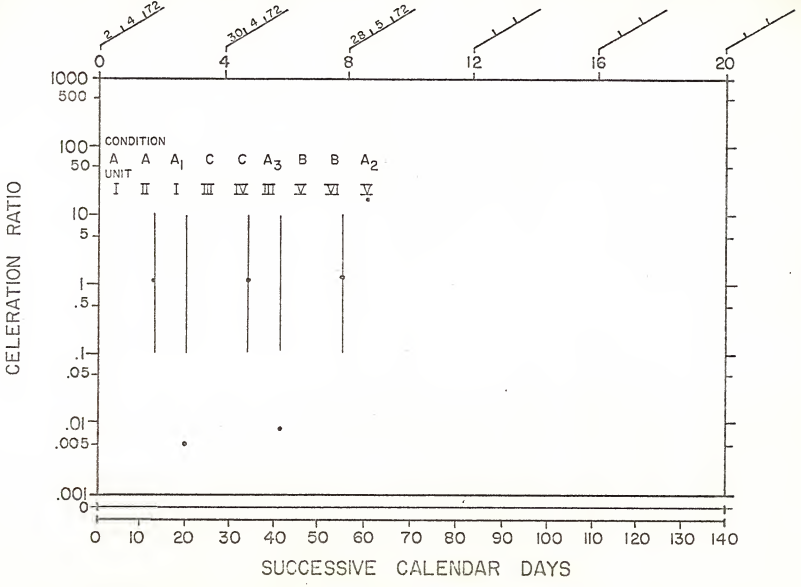

Figure 17. Steve's Celeration Ratio Chart

BIOGRAPHICAL SKETCH

Robert Stephen Spangler was born November 26, 1937, at Palatka, Florida. Three years later, he moved to Jacksonville, Florida. In June, 1956, he was graduated from Bishop Kenny High School. He attended Florida State University at Tallahassee from September, 1957 through August, 1959. He also attended Broward County Junior College as a part-time student from September, 1963 through July, 1964. From August, 1964 until May, 1967, he served in the United States Army, attending the University of Maryland (European Division) in the evenings. He finally received the degree of Bachelor of Arts in Education from the University of Florida in August, 1968. From September, 1968, until September, 1969, he was employed as a classroom teacher at the Florida State Prison at Raiford, Florida while attending Graduate School at night. He held a graduate research assistantship in the Foundations of Education Department at the University of Florida from September, 1969 until August, 1970. In June, 1970, he received the degree of Master of Education. From September, 1970 until June, 1972, he held a graduate teaching assistantship and has pursued his work towards the degree of Doctor of Education.

Robert Stephen Spangler is a member of Phi Kappa Phi, Phi Delta Kappa, the American Educational Research Association, the American Association of University Professors, and the Florida Educational Research Association.

Robert Stephen Spangler is married to the former Hannelore Heidi Brigitte Noack and has three children, Alisa D. Spangler, Robert S. Spangler II, and Francis K. Spangler.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Donald L. Avila, Chairman
Professor of Foundations of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Walter Busby
Assistant Professor of Foundations of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Hal G. Lewis
Professor of Foundations of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

H. S. Pennypacker
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Hannelore Wass
Associate Professor of Foundations of Education

This dissertation was submitted to the Dean of the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Education.

August, 1972

B. L. Sharp by M C Baker
Dean, College of Education

Dean, Graduate School